California STAR Coordinated/Integrated Science Blueprint
Earth Science/Biology/Physics (EBP)

EARTH SCIENCES	ITEMS	PERCENT
Dynamic Earth Processes		
3. Plate tectonics operating over geologic time has changed the patterns of land, sea, and mountains on the Earth's surface. As the basis for understanding this concept:	6	10%
a. *Students know* features of the ocean floor (magnetic patterns, age, and sea-floor topography) provide evidence of plate tectonics.		
b. *Students know* the principle structures that form at the three different kinds of plate boundaries.		
c. *Students know* how to explain the properties of rocks based on the physical and chemical conditions in which they formed, including plate tectonic processes.		
d. *Students know* why and how earthquakes occur and the scales used to measure their intensity and magnitude.		
e. *Students know* there are two kinds of volcanoes: one kind with violent eruptions producing steep slopes and the other kind with voluminous lava flows producing gentle slopes.		
f.* *Students know* the explanation for the location and properties of volcanoes that are due to hot spots and the explanation for those that are due to subduction.		
Total Items in **DYNAMIC EARTH PROCESSES**	**6**	**10%**
Energy In The Earth System		
4. Energy enters the Earth system primarily as solar radiation and eventually escapes as heat. As a basis for understanding this concept:	3	5%
a. *Students know* the relative amount of incoming solar energy compared with Earth's internal energy and the energy used by society.		
b. *Students know* the fate of incoming solar radiation in terms of reflection, absorption, and photosynthesis.		
c. *Students know* the different atmospheric gases that absorb the Earth's thermal radiation and the mechanism and significance of the greenhouse effect.		
d.* *Students know* the differing greenhouse conditions on Earth, Mars, and Venus; the origins of those conditions; and the climatic consequences of each.		

Energy In The Earth System		
5. Heating of Earth's surface and atmosphere by the sun drives convection within the atmosphere and oceans, producing winds and ocean currents. As a basis for understanding this concept:	4	6.5%
a. *Students know* how differential heating of Earth results in circulation patterns in the atmosphere and oceans that globally distribute the heat.		
b. *Students know* the relationship between the rotation of Earth and the circular motions of ocean currents and air in pressure centers.		
c. *Students know* the origin and effects of temperature inversions.		
d. *Students know* properties of ocean water, such as temperature and salinity, can be used to explain the layered structure of the oceans, the generation of horizontal and vertical ocean currents, and the geographic distribution of marine organisms.		
e. *Students know* rain forests and deserts on Earth are distributed in bands at specific latitudes.		
f.* *Students know* the interaction of wind patterns, ocean currents, and mountain ranges results in the global pattern of latitudinal bands of rain forests and deserts.		
g.* *Students know* features of the ENSO (El Niño southern oscillation) cycle in terms of sea-surface and air temperature variations across the Pacific and some climatic results of this cycle.		
6. Climate is the long-term average of a region's weather and depends on many factors. As a basis for understanding this concept:	4	6.5%
a. *Students know* weather (in the short run) and climate (in the long run) involve the transfer of energy into and out of the atmosphere.		
b. *Students know* the effects on climate of latitude, elevation, topography, and proximity to large bodies of water and cold or warm ocean currents.		
c. *Students know* how Earth's climate has changed over time, corresponding to changes in Earth's geography, atmospheric composition, and other factors, such as solar radiation and plate movement.		
d.* *Students know* how computer models are used to predict the effects of the increase in greenhouse gases on climate for the planet as a whole and for specific regions.	.	
Total Items in **ENERGY IN THE EARTH SYSTEM**	**11**	**18%**

Biogeochemical Cycles		
7. Each element on Earth moves among reservoirs, which exist in the solid earth, in oceans, in the atmosphere, and within and among organisms as part of biogeochemical cycles. As a basis for understanding this concept:		
a. *Students know* the carbon cycle of photosynthesis and respiration and the nitrogen cycle.		
b. *Students know* the global carbon cycle: the different physical and chemical forms of carbon in the atmosphere, oceans, biomass, fossil fuels, and the movement of carbon among these reservoirs.		
c. *Students know* the movement of matter among reservoirs is driven by Earth's internal and external sources of energy.		
d.* *Students know* the relative residence times and flow characteristics of carbon in and out of its different reservoirs.		
Total Items in **BIOGEOCHEMICAL CYCLES**	**0**	**0%**
Structure And Composition Of The Atmosphere		
8. Life has changed Earth's atmosphere, and changes in the atmosphere affect conditions for life. As a basis for understanding this concept:		
a. *Students know* the thermal structure and chemical composition of the atmosphere.		
b. *Students know* how the composition of the Earth's atmosphere has evolved over geologic time and know the effect of outgassing, the variations of carbon dioxide concentration, and the origin of atmospheric oxygen.		
c. *Students know* the location of the ozone layer in the upper atmosphere, its role in absorbing ultraviolet radiation, and the way in which this layer varies both naturally and in response to human activities.		
Total Items in **STRUCTURE AND COMPOSITION OF THE ATMOSPHERE**	**0**	**0%**
California Geology		
9. The geology of California underlies the state's wealth of natural resources as well as its natural hazards. As a basis for understanding this concept:	4	6.5%
a. *Students know* the resources of major economic importance in California and their relation to California's geology.		
b. *Students know* the principal natural hazards in different California regions and the geologic basis of those hazards.		
c. *Students know* the importance of water to society, the origins of California's fresh water, and the relationship between supply and need.		
d.* *Students know* how to analyze published geologic hazard maps of California and know how to use the map's information to identify evidence of geologic events of the past and predict geologic changes in the future.		
Total Items in **CALIFORNIA GEOLOGY**	**4**	**6.5%**
TOTAL IN EARTH SCIENCES	**21**	**34.5**

BIOLOGY/LIFE SCIENCES	ITEMS	PERCENT
Cell Biology		
1. The fundamental life processes of plants and animals depend on a variety of chemical reactions that occur in specialized areas of the organism's cells. As a basis for understanding this concept:	4	6.5%
a. *Students know* cells are enclosed within semipermeable membranes that regulate their interaction with their surroundings.		
b. *Students know* enzymes are proteins that catalyze biochemical reactions without altering the reaction equilibrium and the activities of enzymes depend on the temperature, ionic conditions, and the pH of the surroundings.		
c. *Students know* how prokaryotic cells, eukaryotic cells (including those from plants and animals), and viruses differ in complexity and general structure.		
d. *Students know* the central dogma of molecular biology outlines the flow of information from transcription of ribonucleic acid (RNA) in the nucleus to translation of proteins on ribosomes in the cytoplasm.		
e. *Students know* the role of the endoplasmic reticulum and Golgi apparatus in the secretion of proteins.		
f. *Students know* usable energy is captured from sunlight by chloroplasts and is stored through the synthesis of sugar from carbon dioxide.		
g. *Students know* the role of the mitochondria in making stored chemical-bond energy available to cells by completing the breakdown of glucose to carbon dioxide.		
h. *Students know* most macromolecules (polysaccharides, nucleic acids, proteins, lipids) in cells and organisms are synthesized from a small collection of simple precursors.		
i.* *Students know* how chemiosmotic gradients in the mitochondria and chloroplast store energy for ATP production.		
j.* *Students know* how eukaryotic cells are given shape and internal organization by a cytoskeleton or cell wall or both.		
Total Items in **CELL BIOLOGY**	**4**	**6.5%**
Ecology		
6. Stability in an ecosystem is a balance between competing effects. As a basis for understanding this concept:	4	6.5%
a. *Students know* biodiversity is the sum total of different kinds of organisms and is affected by alterations of habitats.		
b. *Students know* how to analyze changes in an ecosystem resulting from changes in climate, human activity, introduction of nonnative species, or changes in population size.		
c. *Students know* how fluctuations in population size in an ecosystem are determined by the relative rates of birth, immigration, emigration, and death.		

Ecology		
d. *Students know* how water, carbon, and nitrogen cycle between abiotic resources and organic matter in the ecosystem and how oxygen cycles through photosynthesis and respiration.		
e. *Students know* a vital part of an ecosystem is the stability of its producers and decomposers.		
f. *Students know* at each link in a food web some energy is stored in newly made structures but much energy is dissipated into the environment as heat. This dissipation may be represented in an energy pyramid.		
g.* *Students know* how to distinguish between the accommodation of an individual organism to its environment and the gradual adaptation of a lineage of organisms through genetic change.		
Total Items in **ECOLOGY**	**4**	**6.5%**
Evolution		
7. The frequency of an allele in a gene pool of a population depends on many factors, and may be stable or unstable over time. As a basis for understanding this concept:	3	5%
a. *Students know* why natural selection acts on the phenotype rather than the genotype of an organism.		
b. *Students know* why alleles that are lethal in a homozygous individual may be carried in a heterozygote and thus maintained in a gene pool.		
c. *Students know* new mutations are constantly being generated in a gene pool.		
d. *Students know* variation within a species increases the likelihood that at least some members of a species will survive under changed environmental conditions.		
e.* *Students know* the conditions for Hardy-Weinberg equilibrium in a population and why these conditions are not likely to appear in nature.		
f.* *Students know* how to solve the Hardy-Weinberg equation to predict the frequency of genotypes in a population, given the frequency of phenotypes.		
8. Evolution is the result of genetic changes that occur in constantly changing environments. As a basis for understanding this concept:	1	1.5%
a. *Students know* how natural selection determines the differential survival of groups of organisms.		
b. *Students know* a great diversity of species increases the chance that at least some organisms survive major changes in the environment.		
c. *Students know* the effects of genetic drift on the diversity of organisms in a population.		
d. *Students know* reproductive or geographic isolation affects speciation.		

Evolution		
e. *Students know* how to analyze fossil evidence with regard to biological diversity, episodic speciation, and mass extinction.		
f.* *Students know* how to use comparative embryology, DNA or protein sequence comparisons, and other independent sources of data to create a branching diagram (cladogram) that shows probable evolutionary relationships.		
g.* *Students know* how several independent molecular clocks, calibrated against each other and combined with evidence from the fossil record, can help to estimate how long ago various groups of organisms diverged evolutionarily from one another.		
Total Items in **EVOLUTION**	**4**	**6.5%**
Physiology		
9. As a result of the coordinated structures and functions of organ systems, the internal environment of the human body remains relatively stable (homeostatic) despite changes in the outside environment. As a basis for understanding this concept:	4	6.5%
a. *Students know* how the complementary activity of major body systems provides cells with oxygen and nutrients and removes toxic waste products such as carbon dioxide.		
b. *Students know* how the nervous system mediates communication between different parts of the body and the body's interactions with the environment.		
c. *Students know* how feedback loops in the nervous and endocrine systems regulate conditions in the body.		
d. *Students know* the functions of the nervous system and the role of neurons in transmitting electrochemical impulses.		
e. *Students know* the roles of sensory neurons, interneurons, and motor neurons in sensation, thought, and response.		
f.* *Students know* the individual functions and sites of secretion of digestive enzymes (amylases, proteases, nucleases, lipases), stomach acid, and bile salts.		
g.* *Students know* the homeostatic role of the kidneys in the removal of nitrogenous wastes and the role of the liver in blood detoxification and glucose balance.		
h.* *Students know* the cellular and molecular basis of muscle contraction, including the roles of actin, myosin, Ca^{+2}, and ATP.		
i.* *Students know* how hormones (including digestive, reproductive, osmoregulatory) provide internal feedback mechanisms for homeostasis at the cellular level and in whole organisms.		

Physiology		
10. Organisms have a variety of mechanisms to combat disease. As a basis for understanding the human immune response:	4	6.5%
a. *Students know* the role of the skin in providing nonspecific defenses against infection.		
b. *Students know* the role of antibodies in the body's response to infection.		
c. *Students know* how vaccination protects an individual from infectious diseases.		
d. *Students know* there are important differences between bacteria and viruses with respect to their requirements for growth and replication, the body's primary defenses against bacterial and viral infections, and effective treatments of these infections.		
e. *Students know* why an individual with a compromised immune system (for example, a person with AIDS) may be unable to fight off and survive infections by microorganisms that are usually benign.		
f.* *Students know* the roles of phagocytes, B-lymphocytes, and T-lymphocytes in the immune system.		
Total Items in **PHYSIOLOGY**	**8**	**13%**
TOTALS IN BIOLOGY/LIFE SCIENCES	**20**	**32.5%**
PHYSICS	**ITEMS**	**PERCENT**
Heat And Thermodynamics		
3. Energy cannot be created or destroyed, although in many processes energy is transferred to the environment as heat. As a basis for understanding this concept:	9	15%
a. *Students know* heat flow and work are two forms of energy transfer between systems.		
b. *Students know* that the work done by a heat engine that is working in a cycle is the difference between the heat flow into the engine at high temperature and the heat flow out at a lower temperature (first law of thermodynamics) and that this is an example of the law of conservation of energy.		
c. *Students know* the internal energy of an object includes the energy of random motion of the object's atoms and molecules, often referred to as *thermal energy*. The greater the temperature of the object, the greater the energy of motion of the atoms and molecules that make up the object.		
d. *Students know* that most processes tend to decrease the order of a system over time and that energy levels are eventually distributed uniformly.		

Heat And Thermodynamics		
e. *Students know* that entropy is a quantity that measures the order or disorder of a system and that this quantity is larger for a more disordered system.		
f.* *Students know* the statement "Entropy tends to increase" is a law of statistical probability that governs all closed systems (second law of thermodynamics).		
g.* *Students know* how to solve problems involving heat flow, work, and efficiency in a heat engine and know that all real engines lose some heat to their surroundings.		
Total Items in **HEAT AND THERMODYNAMICS**	**9**	**15%**
Waves		
4. Waves have characteristic properties that do not depend on the type of wave. As a basis for understanding this concept:	5	9%
a. *Students know* waves carry energy from one place to another.		
b. *Students know* how to identify transverse and longitudinal waves in mechanical media, such as springs and ropes, and on the earth (seismic waves).		
c. *Students know* how to solve problems involving wavelength, frequency, and wave speed.		
d. *Students know* sound is a longitudinal wave whose speed depends on the properties of the medium in which it propagates.		
e. *Students know* radio waves, light, and X-rays are different wavelength bands in the spectrum of electromagnetic waves whose speed in vacuum is approximately 3×10^8 m/s (186,000 miles/second).		
f. *Students know* how to identify the characteristic properties of waves: interference (beats), diffraction, refraction, Doppler effect, and polarization.		
Total Items in **WAVES**	**5**	**9%**
TOTAL IN PHYSICS	**14**	**24%**

INVESTIGATION AND EXPERIMENTATION	ITEMS	PERCENT
1. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other four strands, students should develop their own questions and perform investigations. Students will:	5	9%
a. Select and use appropriate tools and technology (such as computer-linked probes, spreadsheets, and graphing calculators) to perform tests, collect data, analyze relationships, and display data.		
b. Identify and communicate sources of unavoidable experimental error.		
c. Identify possible reasons for inconsistent results, such as sources of error or uncontrolled conditions.		
d. Formulate explanations using logic and evidence.		
e. Solve scientific problems by using quadratic equations and simple trigonometric, exponential, and logarithmic functions.		
f. Distinguish between hypothesis and theory as scientific terms.		
g. Recognize the usefulness and limitations of models and theories as scientific representations of reality.		
h. Read and interpret topographic and geologic maps.		
i. Analyze the locations, sequences, or time intervals that are characteristic of natural phenomena (e.g., relative ages of rocks, locations of planets over time, and succession of species in an ecosystem).		
j. Recognize the issues of statistical variability and the need for controlled tests.		
k. Recognize the cumulative nature of scientific evidence.		
l. Analyze situations and solve problems that require combining and applying concepts from more than one area of science.		
m. Investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. Examples of issues include irradiation of food, cloning of animals by somatic cell nuclear transfer, choice of energy sources, and land and water use decisions in California.		
n. Know that when an observation does not agree with an accepted scientific theory, the observation is sometimes mistaken or fraudulent (e.g., Piltdown Man fossil or unidentified flying objects) and the theory is sometimes wrong (e.g., Ptolemaic model of the movement of the Sun, Moon and planets).		
Total Items in **INVESTIGATION AND EXPERIMENTATION**	**5**	**9%**
TOTAL ITEMS FOR INTEGRATED EBP TEST	**60**	**100%**